

Patent Claims

1. A method for energy-saving operation of a dishwasher (110; 410), in particular for washing dishes (9; 414) or medical appliances, with the dishwasher (110; 410) having a total number $N \geq 2$ of electrical load elements (14, 15, 18, 19, 22, 23, 26, 33; 418, 420, 432, 438), having the following steps:
- 5 a) a group of n electrical load elements (14, 15, 18, 19, 22, 23, 26, 33; 418, 420, 432, 438) is assigned a maximum electrical total power p_{\max} ;
- 10 b) each electrical load element i in the group of n electrical load elements (14, 15, 18, 19, 22, 23, 26, 33; 418, 420, 432, 438) is assigned a finite number m_i of discrete electrical power levels p_{ij} where $m_i \geq 2$:
- 15 - with there being a maximum power level p_{\max} for each i , where $p_{ij} \leq p_{\max}$,
- 20 - where the sum of all maximum power levels p_{\max} form a worst total power $p_{\text{worst}} = \sum_{i=1}^n p_{\max}$ where $p_{\max} < p_{\text{worst}}$, and
- 25 - where a regular power level p_{ireg} exists for each i , where $0 < p_{\text{ireg}} < p_{\max}$ for all i, j , and where $\sum_{i=1}^n p_{\text{ireg}} = p_{\max}$;
- 30 c) an optimum combination of power levels $p_{ij}(B)$ is selected in a demand determination step, as a function of an operating state B of the dishwasher (110; 410),
- where the selected power level $p_{ij}(B)$ for each i is matched to the power demand of the load element i (14, 15, 18, 19, 22, 23, 26, 33; 418, 420, 432, 438) in the operating state B , and

- where: $\sum_{i=1}^n p_{ij}(B) \leq p_{\max}$, for all operating states

B; and

5 d) the electrical power of each load i in the group of n electrical load elements (14, 15, 18, 19, 22, 23, 26, 33; 418, 420, 432, 438) is set to the power level $p_{ij}(B)$, with the maximum power level p_{\max} being assigned, at least during one of the operating states of the dishwasher (110; 410), to at least one load
10 element (14, 15, 18, 19, 22, 23, 26, 33; 418, 420, 432, 438) in the group of n electrical load elements (14, 15, 18, 19, 22, 23, 26, 33; 418, 420, 432, 438).

15 2. The method as claimed in the preceding claim, characterized in that a power level p_{ik} exists for each electrical load i (14, 15, 18, 19, 22, 23, 26, 33; 418, 420, 432, 438), where $0 < k \leq m_i$ and where $p_{ik} = 0$.

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3. The method as claimed in one of the two preceding steps, characterized in that $m_i = 3$ for all i .

25 4. The method as claimed in one of the preceding claims, characterized in that the following method steps are additionally carried out:

e) the dishwasher (110; 410) is started, as a result of which a starting phase begins;

30 f) at least one temperature of at least one washing liquid, in particular a temperature of water in at least one water tank (13, 17, 21; 416, 426) and/or water circuit, is detected;

g) the at least one washing liquid is heated,
- where at least one heating element (14, 18, 22, 26; 418, 432) which heats the washing liquid
35 and forms the load element l where $l \in \{1, \dots, n\}$

is operated at the maximum power level p_{lmax} associated with this heating element (14, 18, 22, 26; 418, 432), and

- where at least one load element q (14, 15, 18, 19, 22, 23, 26, 33; 418, 420, 432, 438) which is not the same as the heating element (14, 18, 22, 26; 418, 432) and where $q \in \{1, \dots, n\}$ and $q \neq 1$ is operated at a lower power than the regular power level p_{qreg} associated with this load element q (14, 15, 18, 19, 22, 23, 26, 33; 418, 420, 432, 438); and

h) as soon as the at least one temperature of the at least one washing liquid has reached or exceeded a predetermined nominal value, a switched-on phase is started,

- where the power of all the load elements i (14, 15, 18, 19, 22, 23, 26, 33; 418, 420, 432, 438) is set to the respectively associated regular power level p_{ireg} .

5. The method as claimed in the preceding claim, having the following additional step:

- i) at least one operating state variable is detected;
- j) at least one operating state variable is allocated a nominal value; and
- k) as soon as the value of the at least one operating state variable differs from the respectively associated nominal value by more than a predetermined tolerance, a load regulation phase is started.

6. The method as claimed in the preceding claim, characterized in that, in the load regulation phase, at least one load element r (14, 15, 18, 19, 22, 23, 26, 33; 418, 420, 432, 438) where $r \in \{1, \dots, n\}$ and which influences the at least one

- operating state variable which differs by more than the predetermined tolerance from its nominal value is operated at a power level which differs from its regular power level p_{rreg} , until the at least one operating state variable once again assumes a value which differs by not more than the predetermined tolerance from its nominal value.
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7. The method as claimed in one of the preceding claims, characterized in that, in method step c), each load element (14, 15, 18, 19, 22, 23, 26, 33; 418, 420, 432, 438) is allocated a priority, and in that the optimum combination of the power levels $p_{ij}(B)$ is determined taking into account the priorities of the load elements (14, 15, 18, 19, 22, 23, 26, 33; 418, 420, 432, 438).
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8. The method as claimed in the preceding claim, characterized in that heating elements (14, 18, 22; 418, 432) which heat washing liquid, in particular water in at least one water tank (13, 17, 21; 416, 426) and/or water circuit, is allocated a higher priority than other loads.
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9. The method as claimed in one of the preceding claims, characterized in that all of the operating states B are characterized by an operating phase variable F and/or by a plurality of operating state variables,
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- where the operating state variable F can assume at least three discrete values (F_1 , F_2 , F_3),
 - where F_1 denotes a starting phase for operation of the dishwasher (110; 410),
 - where F_2 denotes a switched-on phase for operation of the dishwasher (110; 410), and
 - where F_3 denotes the load regulation phase for operation of the dishwasher (110; 410).
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10. An apparatus for energy-saving operation of a dishwasher (110; 410), in particular for washing dishes (9; 414) or medical appliances, with the dishwasher (110; 410) having a total number $N \geq 2$ of electrical load elements (14, 15, 18, 19, 22, 23, 26, 33; 418, 420, 432, 438), having:
- a) means (310) for assignment of a maximum electrical total power p_{\max} to a group of n electrical load elements (14, 15, 18, 19, 22, 23, 26, 33; 418, 420, 432, 438);
 - b) means (310, 332, 334, 336, 338, 340; 452, 454, 456, 458) for assignment of a finite number m_i of discrete electrical power levels p_{ij} to each electrical load element i in the group of n electrical load elements (14, 15, 18, 19, 22, 23, 26, 33; 418, 420, 432, 438),
 - with there being a maximum power level $p_{i\max}$ for each i , where $p_{ij} \leq p_{i\max}$,
 - where the sum of all maximum power levels $p_{i\max}$ form a worst total power $p_{\text{worst}} = \sum_{i=1}^n p_{i\max}$ where $p_{\max} < p_{\text{worst}}$, and
 - where a regular power level $p_{i\text{reg}}$ exists for each i , where $0 < p_{i\text{reg}} < p_{i\max}$ for all i, j , and where $\sum_{i=1}^n p_{i\text{reg}} = p_{\max}$;
 - c) means (310) for selection of an optimum combination of power levels $p_{ij}(B)$, as a function of an operating state B of the dishwasher (110; 410),
 - where the selected power level $p_{ij}(B)$ for each i is matched to the power demand of the load element i (14, 15, 18, 19, 22, 23, 26, 33; 418, 420, 432, 438) in the operating state B , and

- where: $\sum_{i=1}^n p_{ij}(B) \leq p_{\max}$, for all operating states

B; and

d) means (310, 322, 324, 326, 328, 330, 332, 334, 336, 338, 340; 444, 446, 448, 450, 452, 454, 456, 458) for setting the electrical power of each load i (14, 15, 18, 19, 22, 23, 26, 33; 418, 420, 432, 438) in the group of n electrical load elements (14, 15, 18, 19, 22, 23, 26, 33; 418, 420, 432, 438) to the respective power level $p_{ij}(B)$, with the maximum power level p_{\max} being assigned, at least during one of the operating states of the dishwasher (110; 410), to at least one load element (14, 15, 18, 19, 22, 23, 26, 33; 418, 420, 432, 438) in the group of n electrical load elements (14, 15, 18, 19, 22, 23, 26, 33; 418, 420, 432, 438).

11. The apparatus as claimed in the preceding claim, additionally having:

e) means (310) for starting the dishwasher (110; 410) by which means a starting phase is started;

f) means (318, 320) for detection of at least one temperature of at least one washing liquid, in particular a temperature of water in at least one water tank (13, 17, 21; 416, 430) and/or water circuit;

g) at least one heating element (14, 18, 22, 26; 418, 432), which heats the at least one washing liquid and forms the load element l (14, 15, 18, 19, 22, 23, 26, 33; 418, 420, 432, 438) where $l \in \{1, \dots, n\}$, as well as means (322, 324, 326, 328; 448, 450) for operation of the at least one heating element (14, 18, 22, 26; 418, 432) at the maximum power level $p_{l\max}$ associated

- with this heating element, as well as means (322, 324, 326, 328, 330; 444, 446, 448, 450) for operation of at least one load element q (14, 15, 18, 19, 22, 23, 26, 33; 418, 420, 432, 438), which is not the same as the at least one heating element, where $q \in \{1, \dots, n\}$ and $q \neq 1$ at a lower power than the regular power level p_{qreg} associated with this load element q (14, 15, 18, 19, 22, 23, 26, 33; 418, 420, 432, 438); and
- h) means (310) for starting a switched-on phase as soon as the at least one temperature of the at least one washing liquid has reached or exceeded a predetermined nominal value,
- where the power of all the load elements i (14, 15, 18, 19, 22, 23, 26, 33; 418, 420, 432, 438) is set to the respectively associated regular power level p_{ireg} .
12. The apparatus as claimed in the preceding claim, additionally having:
- i) means (318) for detection of at least one operating state variable;
- l) means (310) for assignment of in each case one nominal value to at least one operating state variable; and
- m) means (310) for starting a load regulation phase as soon as the value of the at least one operating state variable differs by more than a predetermined tolerance from the respectively associated nominal value.
13. The apparatus as claimed in the preceding claim, having additional means (322, 324, 326, 328, 330; 444, 446, 448, 450) for operation of at least one load element r (14, 15, 18, 19, 22, 23, 26, 33; 418, 420, 432, 438) where $r \in \{1, \dots, n\}$ which

influences the at least one operating state variable which differs by more than the predetermined tolerance from its nominal value at a power level, which differs from its regular power level p_{rreg} , in the load regulation phase, until the at least one operating state variable once again assumes a value which differs from its nominal value by not more than the predetermined tolerance.

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14. The apparatus as claimed in one of the preceding apparatus claims, characterized in that the means c) (310) for selection of an optimum combination of power levels $p_{ij}(B)$ have means (310) for allocation of a priority to each load element (14, 15, 18, 19, 22, 23, 26, 33; 418, 420, 432, 438) as a function of an operating state B of the dishwasher (110; 410), where the optimum combination of the power levels $p_{ij}(B)$ is determined taking into account the priorities of the load elements (14, 15, 18, 19, 22, 23, 26, 33; 418, 420, 432, 438).

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15. The apparatus as claimed in one of the preceding apparatus claims, characterized in that the dishwasher is a multiple tank dishwasher (110).

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16. The apparatus as claimed in one of the preceding apparatus claims, characterized in that the means b) (310, 332, 334, 336, 338, 340; 452, 454, 456, 458) for assignment of a finite number m_i of discrete electrical power levels p_{ij} to each electrical load element (14, 15, 18, 19, 22, 23, 26, 33; 418, 420, 432, 438) and/or the means c) (310) for selection of an optimum combination of power levels $p_{ij}(B)$ as a function of an operating

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state B of the dishwasher (110; 410) have/has a look-up table (314) and/or an electronic table.

17. A computer program having program code means in
5 order to carry out a method as claimed in one of
the preceding method claims, when the computer
program is run on a computer (310) or a computer
network.
- 10 18. A computer program having program code means as
claimed in the preceding claim, which program code
means are stored on a computer-legible data
storage medium (314).